

Grades 9–12: Number and Operations

STANDARD **I.** Understand numbers, ways of representing numbers, relationships among numbers, and number systems.

EXPECTATION **A.** Develop a deeper understanding of very large and very small numbers and of various representations of them.

1. Read, write, and represent very large and very small numbers in a variety of forms including exponential and radical.

EXPECTATION **B.** Compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions.

1. Identify the kinds of equations that can and cannot be solved in each subset of the complex number system.

EXPECTATION **C.** Understand vectors and matrices as systems that have some of the properties of the real number system.

1. Use vectors to represent situations that involve both magnitude and direction, such as force, displacement, velocity, and acceleration.

2. Identify and use properties related to operations with matrices to justify the steps in solving problems that arise from applications.

EXPECTATION **D.** Use number-theory arguments to justify relationships involving whole numbers.

*1. Use the commutative, associative, distributive, equality, and identity properties to justify the steps in solving equations and inequalities.

*2. Use symbolic representation, reasoning, and proof to verify statements about numbers.

STANDARD II. Understand meanings of operations and how they relate to one another.

EXPECTATION A. Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities.

*1. Recognize and justify the relationship between the magnitude of a number and the application of specific arithmetic operations.

EXPECTATION B. Develop an understanding of properties of, and representations for, the addition and multiplication of vectors and matrices.

*1. Organize data and perform operations of addition, subtraction, and scalar multiplication to solve problems using matrices.

EXPECTATION C. Develop an understanding of permutations and combinations as counting techniques.

1. Determine the relationship between counting when order matters and when order does not matter.

STANDARD III. Compute fluently and make reasonable estimates.

EXPECTATION A. Develop fluency in operations with real numbers, vectors, and matrices, using mental computation or paper-and-pencil calculations for simple cases and technology for more complicated cases.

1. Given a problem situation, determine whether to use a rough estimate, an approximation, or an exact answer. Select a suitable method of computing from techniques such as the use of mental mathematics, paper and pencil computations, calculators, and computers.

EXPECTATION B. Judge the reasonableness of numerical computations and their results.

*1. Explain why a solution is mathematically reasonable using supporting data.